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PRELIMINARY SITE CHARACTERIZATION DATA FOR SWSA-6

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Environmental Sciences Division

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OAK RIDGE NATIONAL LABORATORY

Oak Ridge, Tennessee 37831

Operated By

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SUMMARY

I. INTRODUCTION

I.1 Site Location and History

The Oak Ridge Reservation (about 23,900 hectares or 59,000 acres) is located in a broad valley between the Cumberland Mountains, which lie to the northwest of the area, and the Great Smoky Mountains, to the southeast. The Reservation is located about (25 miles) west of Knoxville, Tenn. and about (150 miles) east of Nashville, Tenn. Figure 1 illustrates the location of the Reservation relative to surrounding communities. The incorporated places within (50 miles) of the site are Knoxville (183,139), Oak Ridge (27,662), Clinton (5245), Kingston (4441), Oliver Springs (3659), Harriman (8303), and Lenoir City (5446) (USDOC 1982).

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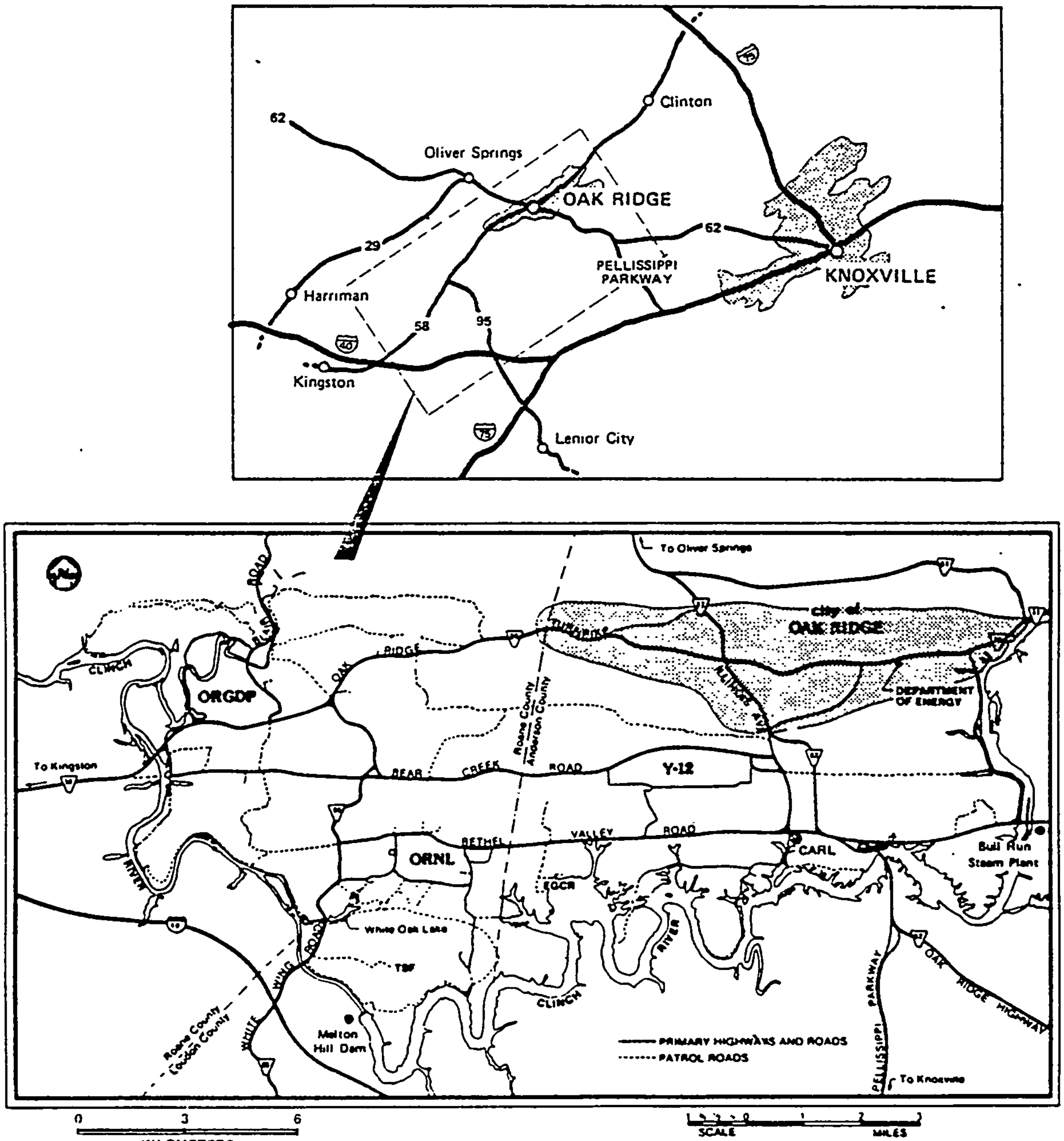

Fig. 1. Map showing location of ORNL on the Oak Ridge Reservation and the relationship to surrounding communities.

The Oak Ridge National Laboratory (ORNL) is located in the southwest portion of the Oak Ridge Reservation (Fig. 1), and has been in operation since 1942. Low-level radioactive wastes (LLW) have been disposed at ORNL since its inception; to date six burial grounds (Solid Waste Storage Areas or SWSA's) have been used for this purpose (Sease et al. 1982). Fig. 2 illustrates the locations of the six SWSAs relative to ORNL. The first three locations were chosen mainly due to proximity to the waste sources, whereas the last three were located following recommendations of geologic and hydrologic studies (Boyle et al. 1982). To date, is is estimated that about 170,000 m^3 (6×10^6 ft^3) of LLW has been buried at ORNL (Gilbert/Commonwealth 1980).

Although some low-level waste was buried in SWSA-6 as early as 1969, major burials at the site were not initiated until SWSA-5 was closed in 1973 (Webster 1976). The area selected for SWSA-6 (see Fig. 3 and 4) is located in Melton Valley, northwest of White Oak Lake and southeast of Lagoon Road and Haw Ridge (Webster 1976). The site includes 28 hectares (68 acres), of which about one half is reported to be suitable for waste burial. The balance of the site consists of steep slopes and areas having shallow ground water which might not be satisfactory for burial operations (Lomenick and Wyrick 1965).

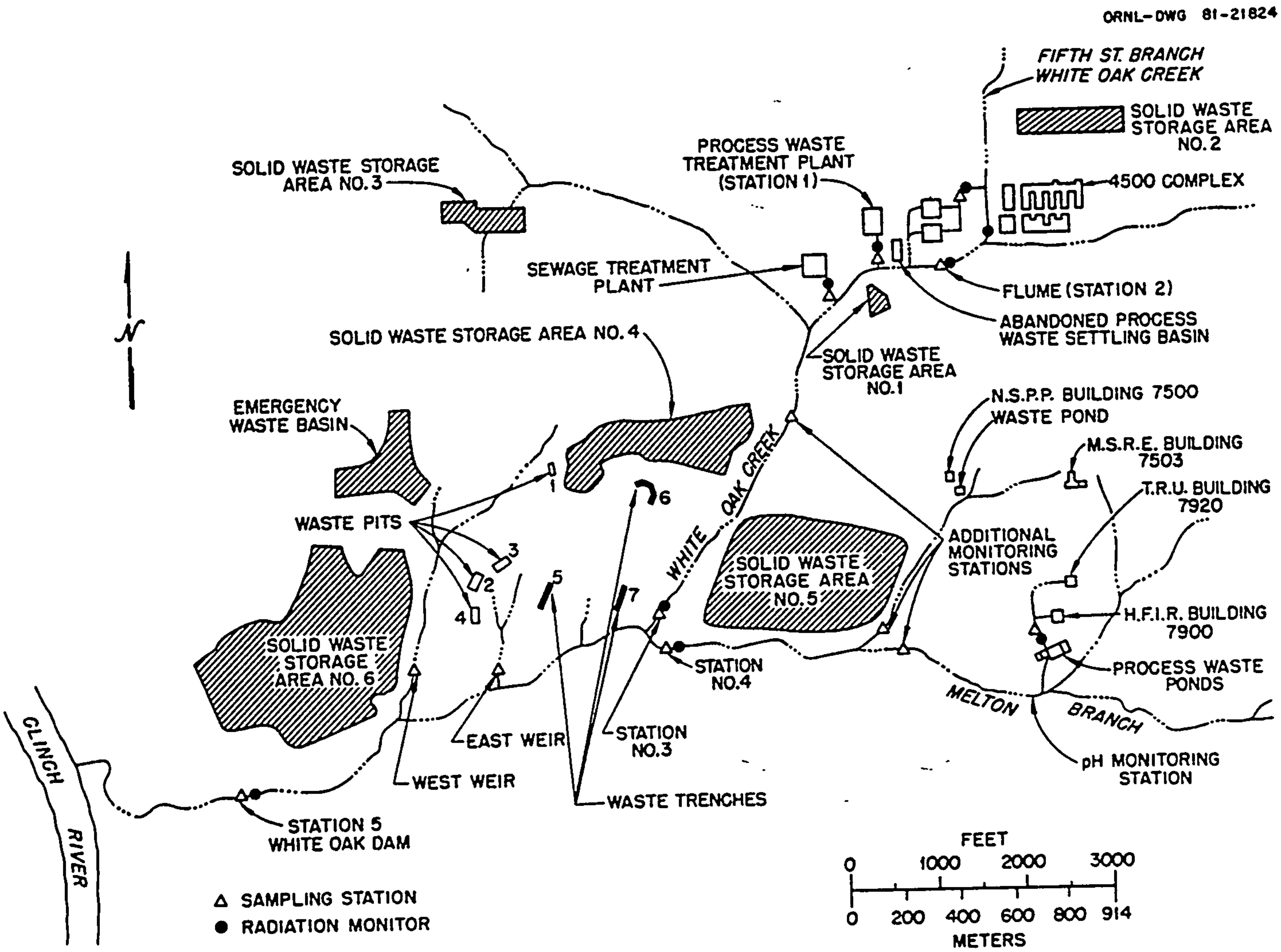

FIG. 2. LOCATION OF SOLID WASTE STORAGE AREAS (SWSAs) AT ORNL.

ORNL PHOTO 0079-78

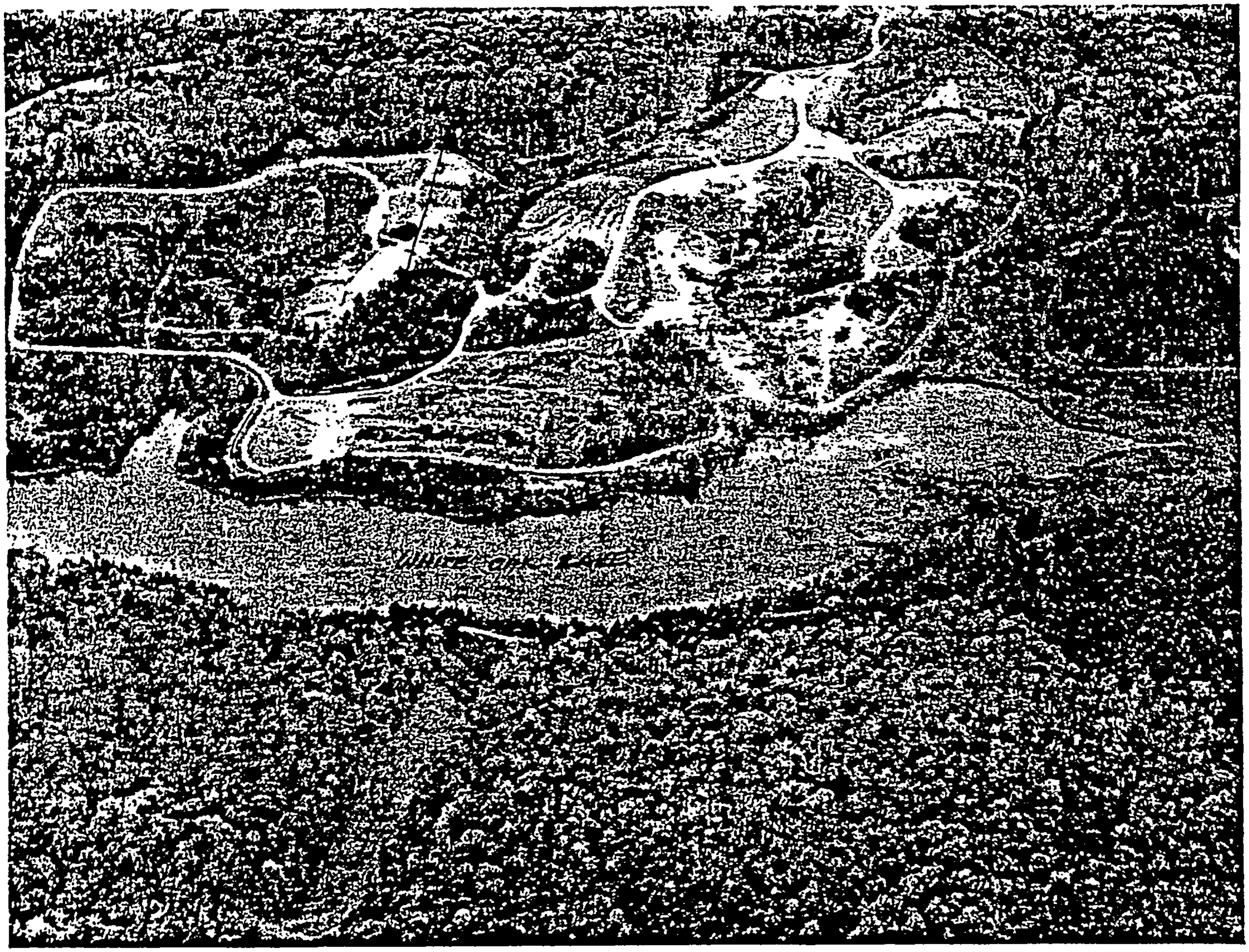

Fig. 3. Photograph of SWSA 6, LOOKING NORTHWEST

OUTLINE SITE BOUNDARYS
NORTH ARROW ?

Use Photo
from Dev & Constr
report
Showing ETF

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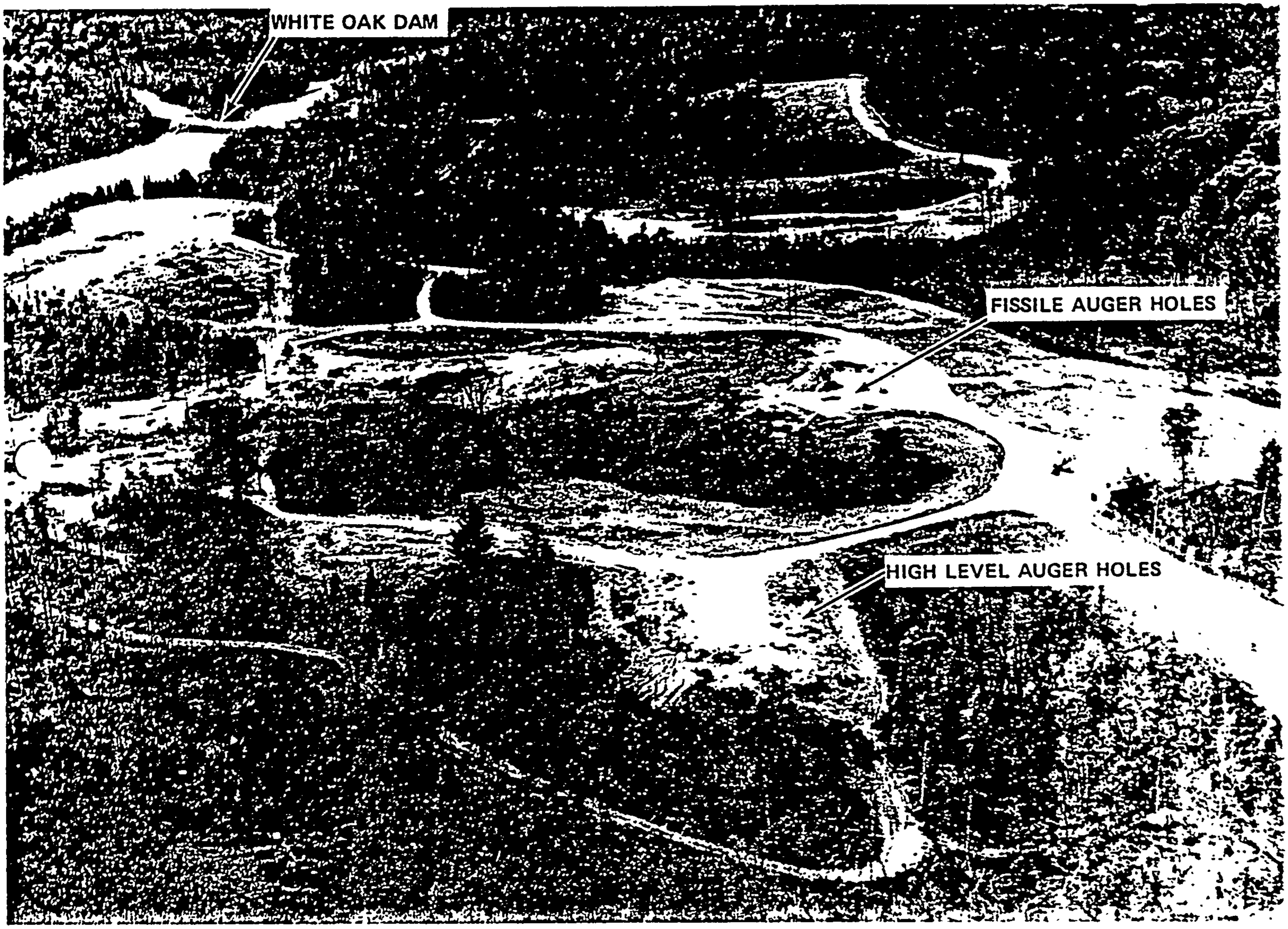

Fig. 4. SWSA-6 site photograph, LOOKING SOUTHWEST

I.2 Operational Status of SWSA-6

ORNL disposes or stores all radioactive solid waste generated at the Laboratory as well as solid waste for which DOE-ORO authorizes acceptance from other DOE contractors, licensees, or other government agencies. The Operations Division is responsible for providing, planning, organizing, leading, and controlling activities relating to disposal/storage, as well as supervising associated field services connected with SWSA activities at ORNL (Bates 1983).

Waste Classifications

Solid wastes buried at ORNL can be classified by two sources; ORNL wastes, and off-site wastes. ORNL waste is further broken down into routine wastes which are those for which procedures have been prepared and/or which meet package content requirements and surface radiation limits for radioactivitity with sufficient consistency that they represent no significant hazard in handling/disposal/storage operations. Wastes which do not meet these criteria are considered nonroutine wastes and are subject to specialized handling/disposal/storage. Most of the waste generated at ORNL (in volume and activity) are considered to fall in the routine category. Off-site shipments require special approval from DOE-ORO and ORNL, and must comply with applicable DOE and DOT packaging and shipping regulations.

For disposal/storage purposes, ORNL classifies solid radioactive wastes as being in one of five categories: ^{233}U/transuranium waste, ^{235}U waste, general radioactive waste (radwaste), mixed wastes, and low-hazard contaminated waste. Essentially all of the waste buried in SWSA-6 relates to the last three categories. Transuranium wastes must be retrievably stored for a minimum of 20 years (DOE Order 5820), and ^{235}U wastes are no longer generated in significant quantities at ORNL. General radioactive wastes are divided into two classes depending on the radiation level. High-activity waste has a radiation level of greater than 200 mr/hr at the surface of the container, and low-level radwaste is 200 mr/hr or less. Low-level radwaste is further subdivided into compactible and noncompactible fractions so that the compactible material can be reduced to minimum volume prior to burial. General radwastes are disposed in trenches or unlined auger holes, with auger holes being used for the high-activity fraction when required. Mixed wastes contain a combination of two of the first three categories of radionuclides. Disposal/storage is based on the most hazardous component present. The final category (low-hazard contaminated waste) has no measurable contamination, however it has been judged by the generator to be radioactively contaminated above ORNL "green tag" limits. This waste is also described as "suspect" waste, and is segregated from low-level waste in separate trenches.

Currently, ORNL low-level radioactive waste is segregated at the source by the waste generator into compactible (paper, plastics, cloth, etc.) and noncompactible waste (metals, glass, concrete, etc.) prior to collection and disposal. Furthermore, compactible wastes cannot contain liquids. Handling procedures for radwastes generated at ORNL are described in Section 5.1 of the "Health Physics Procedure Manual."

Each shipment to SWSA-6 must have a "Request for Storage or Disposal of Radioactive Solid Waste or Special Materials" (Form UCN-2822) filled out prior to collection. This form details the waste classification, type of waste, type and number of containers, and estimates of the isotopes present in grams or curies. The form provides for health physics concurrence with this information plus measurements of the radiation level and surface contamination of the package(s). The Operations Division completes the balance of the form, indicating what was done with the waste, where it was placed, a specific location within the disposal/storage facility, and other miscellaneous information. A copy of the completed form is returned to the waste generator. Data from this form is entered into a computer data records system for storage. Appendix B gives a summary of this information for SWSA-6 in terms of the quantity of waste buried, the type of waste, and total activity for each year of operation and the totals to date.

Disposal Procedures

New trenches are located in SWSA-6 based on historical data on water table elevations (see Section IV.2), with the depth of the trench maintained at 2 feet less than the highest recorded water level shown on the water table map (Fig. 10). Trenches are nominally 15 m (50 ft) long and 3 m (10ft) wide depending on specific site topography. Depth is nominally 3 to 4.25 m (10 to 14 ft) with the depth of a specific trench being determined by the depth of the water table. All trenches must have their bottom at least 0.6 m (2 ft) above the water table, when a trench is excavated and water is found, the trench is backfilled with Conasauga shale to a depth at least 0.6 m above the observed depth of water. Spacing between trenches is limited to 1.5 m (5 ft). Details of a typical trench are shown in Fig. 5. Filling of a trench occurs over a period of time with appropriate markers and barricades identifying the open trench. Waste is deposited in the trench from radwaste dumpsters, by placement of individual packages, or as bulk waste in truck lots. When the level of waste approaches a level that is less than 1 m (3 ft) of the top of the trench the trench is backfilled with soil and packed by running heavy equipment over the trench. Once the trench is backfilled the area is seeded to minimize erosion. Later, when sufficient trenches have been covered in a given area the trenches are sealed with a bentonite clay-Conasauga shale mixture to reduce

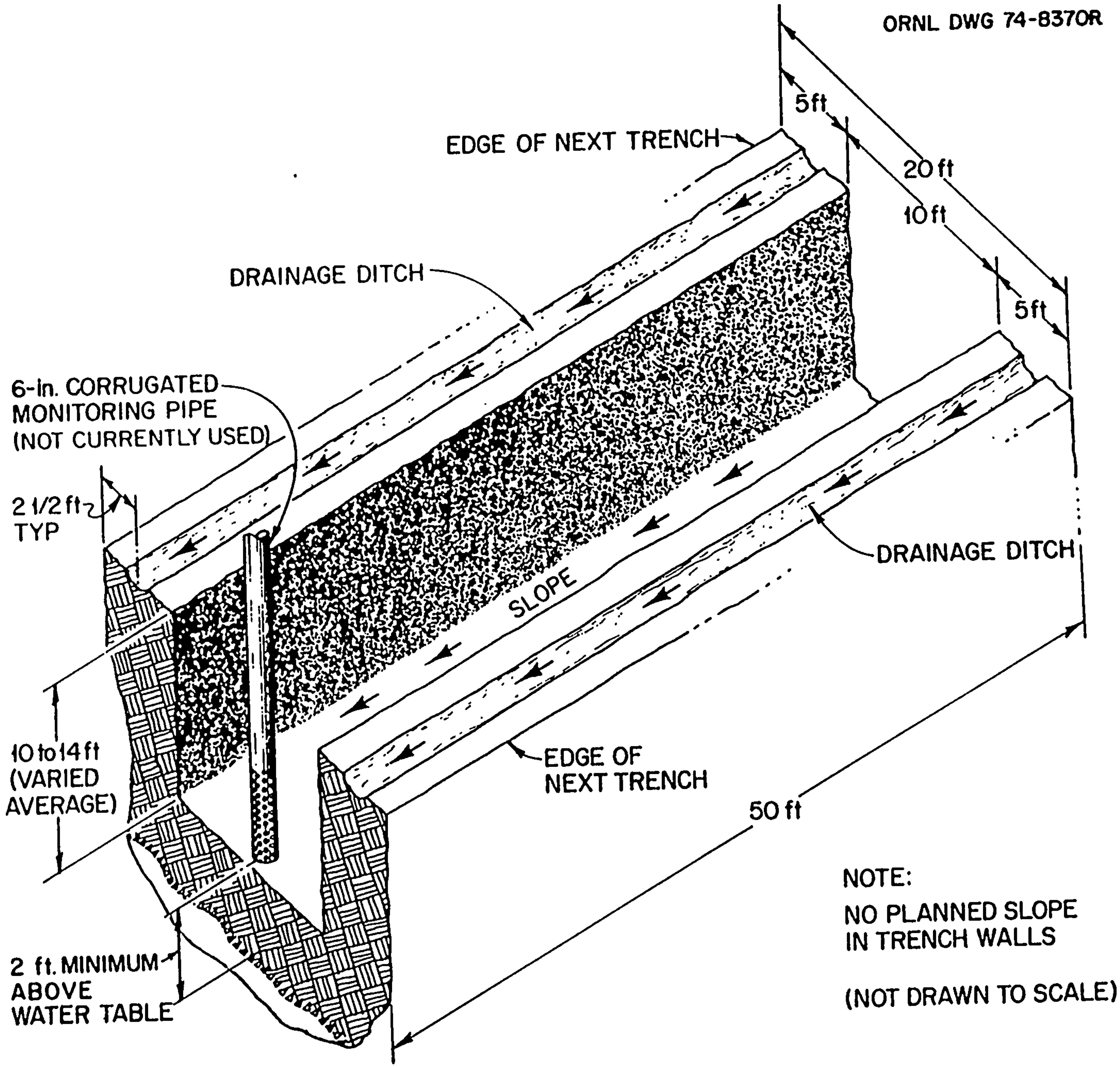

FIG. 5 CROSS SECTION OF A TYPICAL TRENCH

water infiltration. This seal is at least 10 cm (4 in.) thick and contains not less than 12% by volume granular bentonite clay. This mixture is sprayed with water to achieve a water content of 20% and then covered with not less than 0.6 m (2 ft) of shale/dirt before final seeding. The monitoring pipe shown in Fig. 5 is no longer installed prior to addition of waste, instead it is installed after the trench is filled, covered, and the final bentonite seal installed. The monitoring well is located on the centerline of the trench about 1.2 m (4 ft) from the lower end of the trench. Installation is by augering to the bottom of the trench, placement of a 10 cm (4 in.) plastic pipe (slotted in the lower 1 m (3 ft), backfilling the annulus with gravel followed by a bentonite-shale seal to within 20 cm (8 in.) of surface, and a concrete collar [approximately 0.8 m (30 in.) diameter] to locate and protect the well. The collar is marked with the well number and the well is closed with a loose cover. When this is completed the area is surveyed and the location of the corners of the trench recorded. At the present time markers are not placed at the corners of the trench, the location of the monitoring pipe designates the general location of the trench.

Auger holes are basically a specialized form of trench burial utilized to allow greater control of radiation exposures during disposal operations and to limit excessive quantities of fissionable material from accumulating in a given area. Detailed practices and procedures have been developed over numerous years of experience. Auger hole diameters are not standardized, but vary depending of the function and the material being emplaced. A Most of the holes are about 1 m (40 in.) in diameter and the depth is such that 0.6 m (2 ft) of earth separates the bottom of the hole and the highest known water table. Auger holes are spaced a minimum of 0.9 m (3 ft) edge to edge. An auger hole is closed when either the waste is within 0.9 m (3 ft) of the surface, or in the case of fissile material, when 200 g of fissile isotopes are contained. Closure is by backfilling with soil to within 0.6 m (2 ft) of the surface, adding 0.25 m (8 to 12 in.) of concrete followed by additional soil.

I.3 Status of Compliance with DOE 5820

Currently commercial burial grounds are regulated by the US Nuclear Regulatory Commission (USNRC) using 10 CFR 61, whereas burial grounds containing defense wastes are regulated by US Department of Energy (USDOE) under DOE Order 5820. Both sets of regulations are essentially the same, with differences existing mainly in the level of details required prior to selecting the site and operating the facility. Much of this detail is needed for commercial burial grounds because they are subject to more detailed public scrutiny and would be located at sites not initially owned and controlled by the federal government. Burials in

SWSA-6 will be required to comply with 5820 for any operations continuing after implementation of the order, and will be required to meet the closure requirements for areas in which burial has been completed. ORNL is committed to completing the long-term stabilization of existing solid waste storage areas by the fourth quarter of FY 1987.

The purpose of this report is to collect and compile existing site information regarding SWSA-6, and evaluate additional data needs to enable an assessment of the potential environmental consequences of SWSA-6. As such, this document represents the initial step in compiling information required for evaluating future compliance with DOE Order 5820. Previous studies (See Appendix A) have provided considerable background information on the Oak Ridge Reservation, however, there has been no attempt made to compile site characterization information on SWSA-6 into a single volume. Lomenick and Wyrick (1965) prepared a geohydrologic report on SWSA-6 prior to operation, and Boyle et al. (1982) have summarized the current status of the burial grounds; most other documents deal with specific research studies conducted since operations began at SWSA-6.

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April 1, 1984

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Appendix A -- Literature Sources on SWSA-6

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Appendix B -- Waste Inventory

(DATA HAS BEEN REQUESTED FROM GRIZZARD)

add

SOLID WASTE STATISTICS

Detailed records are kept of SWSA usage and are published quarterly in the "Solid Waste Storage Management Quarterly Report." In recent years the wastes have been segregated into transuranic, fissile, high-level, etc.; and totals have been accumulated for individual categories. The following tables summarize information from the quarterly reports and other sources and provide data regarding the total waste volumes, curies, land usage, etc., through FY-81.

Table B.1. Land used for solid waste disposal

	Total (all SWSA)		~~SWSA-5~~		SWSA-6	
	meters^2	(acres)	meters^2	(acres)	meters^2	(acres)
Prior to FY-82	356,744[a]	(88.17)[a]	202,452[a]	(50.04)[a]	30,466[a]	(7.53)[a]
FY 1981	1,875	(0.46)	63	(0.02)	1,510	(0.38)
FY 1980	2,840	(0.70)	8	(0.002)	2,832	(0.70)
FY 1979	3,277	(0.81)	81	(0.02)	3,196	(0.79)
FY 1978	3,237	(0.80)	81	(0.02)	3,156	(0.78)
FY 1977	3,196	(0.79)	202	(0.05)	2,994	(0.74)
TQ 1976[b]	1,052	(0.26)	41	(0.01)	1,012	(0.25)
FY 1976	4,046	(1.00)	364	(0.09)	3,682	(0.91)
FY 1975	4,248	(1.05)	41	(0.01)	4,208	(1.04)

[a]Corrected to most recent civil engineering data.

[b]Third Quarter FY 1976 - see Note (A) Table 4.7.

Will be brought up to date

will get this for SWSA-6 only

B-2

Table ~~[illegible]~~. Total radioactive waste in SWSAs

	Volume		General radwaste		Landfill waste		Transuranic		Fissile waste	
	m^3	(ft^3)	m^3	(ft^3)	m^3	(ft^3)	m^3	(ft^3)	m^3	(ft^3)
Prior to FY-82	194,158.1	(6,858,288)	191,569.2[a]	(6,766,840)[a]	499.4	(17,640)	1,953.3	(68,998)	325.8	(11,508)
FY 1981[b]	1,784.1	(63,021)	1,609.3[b]	(56,845)	111.9	(3,954)	62.2	(2,200)	0.4	(12)
FY 1980	2,343.4	(82,775)	2,046.1	(72,275)	230.3	(8,135)	55.5	(1,961)	2.7	(96)
FY 1979	2,109.0	(74,496)	1,917.3	(67,726)	116.0	(4,099)	75.2	(2,658)	0.4	(13)
FY 1978	2,384.5	(84,228)	2,265.6	(80,028)	41.1	(1,452)	74.9	(2,647)	2.9	(101)
FY 1977	2,223.3	(78,534)	2,133.1	(75,348)			84.5	(2,986)	5.7	(200)
TQ FY 1976	788.8	(27,862)	714.8	(25,250)			73.7	(2,604)	0.2	(8)
FY 1976	2,788.5	(98,498)	2,643.5	(93,376)			141.5	(4,999)	3.5	(123)
FY 1975	3,196.3	(112,904)	3,001.6	(106,027)			144.2	(5,093)	50.5	(1,784)

[a]Includes 2.01 m^3 (71 cu ft) of retrievable $\beta-\gamma$ contaminated storage.

[b]Values corrected to most recent calculations.

Table 4.7. Total annual activity, volume, and weight of solid waste buried or stored

Fiscal year	Activity (Ci)	Volume (ft^3)	Volume (m^3)	Weight (lb)	Weight (kg)
43	2.0×10^3	2.5×10^4	700	3.0×10^5	1.4×10^5
44	2.0×10^3	2.5×10^4	700	3.0×10^5	1.4×10^5
45	2.0×10^3	2.5×10^4	700	3.0×10^5	1.4×10^5
46	2.0×10^3	2.5×10^4	700	3.0×10^5	1.4×10^5
47	1.0×10^4	1.4×10^5	3960	2.0×10^6	1.4×10^5
48	1.0×10^4	1.4×10^5	3960	2.0×10^6	1.4×10^5
49	1.0×10^4	1.4×10^5	3960	2.0×10^6	1.4×10^5
50	1.0×10^4	1.4×10^5	3960	2.0×10^6	1.4×10^5
51	1.0×10^4	1.4×10^5	3960	2.0×10^6	1.4×10^5
52	1.0×10^4	2.0×10^5	5660	2.0×10^6	1.4×10^5
53	1.0×10^4	2.0×10^5	5660	2.0×10^6	1.4×10^5
54	1.0×10^4	2.0×10^5	5660	2.0×10^6	1.4×10^5
55	1.0×10^4	2.0×10^5	5660	2.0×10^6	1.4×10^5
56	1.0×10^4	2.0×10^5	5660	2.0×10^6	1.4×10^5
57	2.0×10^4	2.0×10^4	9060	4.0×10^6	1.8×10^6
58	2.0×10^4	3.2×10^5	9060	4.0×10^6	1.8×10^6
59	2.0×10^4	3.2×10^5	9060	4.0×10^6	1.8×10^6
60	2.0×10^4	3.2×10^5	9060	4.0×10^6	1.8×10^6
61	4.0×10^4	5.31×10^5	15000	6.0×10^6	2.7×10^6
62	3.0×10^4	4.24×10^5	12000	5.0×10^6	2.3×10^6
63	2.0×10^4	3.33×10^5	9430	4.0×10^6	1.8×10^5
64	2.0×10^4	3.21×10^5	9090	4.0×10^6	1.8×10^6
65	1.0×10^4	1.89×10^5	5350	2.0×10^6	9.1×10^5
66	1.0×10^4	1.59×10^5	4500	2.0×10^6	9.1×10^5
67	1.0×10^4	1.99×10^5	5640	2.0×10^6	9.1×10^5

Table G.3. (continued)

Fiscal year	Activity (Ci)	Volume (ft^3)	Volume (m^3)	Weight (lb)	Weight (kg)
68	2.0×10^4	2.42×10^5	6850	3.0×10^6	1.4×10^6
69	1.0×10^4	1.92×10^5	5440	2.0×10^6	9.1×10^5
70	1.0×10^4	1.28×10^5	3630	1.0×10^6	4.5×10^5
71	1.1×10^4	1.67×10^5	4730	2.29×10^6	1.0×10^6
72	1.0×10^4	1.29×10^5	3650	1.90×10^6	8.6×10^5
73	9.0×10^3	1.07×10^5	3030	1.57×10^6	7.1×10^5
74	8.8×10^3	1.20×10^5	3400	1.55×10^6	7.0×10^5
75	2.0×10^3	1.12×10^5	3170	1.41×10^6	6.4×10^5
76(A)	1.1×10^4	1.25×10^5	3540	1.49×10^6	6.8×10^5
77	2.0×10^4	7.77×10^5	2200	6.37×10^5	1.7×10^5
78	5.25×10^3	8.32×10^5	2360	9.24×10^5	4.2×10^5
79	5.55×10^4	7.45×10^4	2110	1.34×10^6	6.1×10^5
80	6.32×10^4	8.29×10^4	2350	1.31×10^6	6.0×10^5
81	1.16×10^5	6.37×10^4	1800	1.68×10^6	7.6×10^5

(A)July 1, 1975 through September 30, 1976 - Reflects change in fiscal year to begin in October.

Will be updated for SWSA-6 rly

4-2001

Table 2.1a. Fissile waste in SWSAs

	Volume m^3	Volume (ft^3)	Fissile isotopes (g)	Number of auger holes	Number of trenches
Prior to FY-82	325.4	(11,494)	22,833	222	8
FY 1981	0.4	(12)	210	3	0
FY 1980	2.7	(60)	958	3	0
FY 1979	0.4	(13)	39	2	0
FY 1978	2.5	(87)	1,261	14	0
FY 1977	5.7	(200)	1,728	8	0
TQ FY 1976	0.2	(8)	2	1	0
FY 1976	3.5	(123)	1,225	6	1
FY 1975	50.5	(1,784)	1,992	7	4
FY 1974	58.9	(2,082)	1,915	9	1
FY 1973	33.8	(1,195)	2,128	40	0
FY 1972	101.2	(3,576)	7,289	76	1
FY 1971[a]	48.3	(1,705)	2,784	36	1
FY 1970[b]	17.4	(613)	1,302	16	0

[a]Transuranium Waste Storage Facility initiated October 1970.

[b]First year of separation of transuranic from nontransuranic waste. Prior to this, wastes containing isotopes ^{233}U, ^{235}U, and ^{239}Pu were placed below grade in the same section, SWSA-5.

Only as it involves SWSA-6 may be left out!

Appendix C -- Groundwater Data for SWSA-6

Water Level Elevations

(SUMMARIZE WEBSTERS IN SOME FASHION -- UPDATE TO 1983??)

Water Quality Analyses

(REQUEST FROM TOM OAKES GROUP)

Appendix D -- DOE Order 5820